E/CONF.39/A/11
26 Sept.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item : A.2

Ceylon

INTEGRATED RIVER BASIN DEVELOPMENT IN LESS DEVELOPED AREAS IN CEYLON

By V. N. RAJARATNAM
Assistant Director,
Irrigation Department, Ceylon

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INTEGRATED RIVER BASIN DEVELOPMENT IN LESS DEVELOPED AREAS IN CEYLON.

by

V. N. RAJARATNAM.

(Assistant Director, Irrigation Department, Ceylon)

1. Development of less developed areas in Ceylon.

(a) Wet and dry zones of the Island.

The country divides itself into two distinct zones called the wet and dry zones according to rainfall. The zone has two rainy seasons with an average annual rainfall of 110 inches spread over the two seasons. The dry zone has one rainy season with an average annual rainfall of 60 inches of which 80% is concentrated in the three months of the rainy season. The wet zone covers the South Western sector of the island and the dry zone comprises the rest.

The pattern of agricultural development of the island has been influenced by the weather conditions in the two zones. Thus the wet zone with its abundant moisture and steady temperatures, has been fully developed under economic crops such as tea, rubber, coconuts, and rice which is the main subsistence crop. The present economy of the island therefore is dependent almost entirely on the wet zone which is only a third of the area of the dry zone, and having the largest concentration of population. The dry zone, although it has one rainy season, subsistence crop such as rice, cannot be cultivated successfully without irrigation. Without water the land in the dry zone has no value but the rainfall here is such that with storage best use of the water can be made. The development of this area therefore lies in the effective planning of its land and water resources.

(b) General characteristics of the dry zone.

Dry zone area in ancient times supported a large population and the main activity had been the production of rice and other subsistance crops. The art of irrigation was practised in this country for more than twenty centuries and there still remain to this day some of the reservoirs and diversion structures which the ancient people had constructed. But now the dry zone is an unpeopled land as jungle covers the greater part of it. In many parts of the dry zone the population is below 50 person to the Sq.Mile. The

people are found in small settlements in isolated villages near rivers and tanks (artificial reservoirs) where they earn a meagre livelihood on the fringes of the jungle.

(c) Present stage of Development of the dry zone.

It has been stated earlier that this region has only one rainy season, and cultivation of subsistence crops is attendant with hazards on account of the vagaries of the monsoon. Most of the unused lands lie in this region but the lands can only be developed by irrigation.

The governmental activity since the turn of the century was exclusively directed to restoring, maintaining and operating the ancient irrigation schemes. Then a slump in 1931 in the principal commodities of the country, tea, rubber and coconut reduced employment in the parts of the wet zone where those industries are situated and brought about the vital necessity for expansion to the dry zone as a means of livelihood to the people.

The population pressure in the wet zone forced the government to initiate a scheme of Colonisation and land utilisation in the dry zone. The general policy of the Government had been to establish the peasant on a unit of holding consisting of a wet - land area and a high-land area to enable him to settle on the land and derive from it an income sufficient to maintain himself and his family in reasonable circumstances. He is to obtain the money income from the wet land by rice cultivation while his homestead is to be on the high-land at a reasonable distance from the wet land where besides his home he can cultivate it with permanent crops and vegetable mainly to meet his own requirements of food.

In the earlier schemes, the wet land unit was 5 acres and the high-land 3 acres. These units were based on the agricultural produce prevailing in 1935. As the price of agricultural produce improved, the demand for land by the peasant settlers increased and it was then decided to reduce to 3 acres of wet-land and 2 acres of high-land. The new projects are being planned and constructed on this basis.

Due to colonisation projects, development under irrigation in the areas where the projects were situated showed better progress. The lands developed in the dry zone under irrigation is now approximately 0.35 million acres.

(d) Pattern of future development in the dry zone.

1. Need for further development.

Ceylon is essentially an agricultural country but she spends annually a large amount of money in importing basic food and other commodities which is a large drain on the national income. By producing these commodities locally, the savings effected in expenditure could be utilised in developing other requirements which are necessary for national security and well being. There is thus a great

need for the development of land and water resources so as to make the country self-sufficient in those articles of food and essential goods which could be produced in the country economically.

Dry zone needs water for the cultivation of rice which is the staple food of the people. For any programme aiming at the increase of rice production an assured supply of irrigation water is a prime necessity. Many of the existing minor irrigation schemes do not meet this requirement as they depend on uncertain natural stream flow during the rainy season. The rainfall varies greatly from one part of the country to another, from one season of the year to another, as well as from one year to the next. Thus if the rains are late, the whole cultivation programme receives a set back as tanks are not replenished in time to commence cultivation and in the dry zone owing to shortage of water only one crop of rice a year could be grown.

Water is also required for developing hydro-electric power as the country has no known fuel resources for producing thermal power. It is also required for domestic and industrial use as very little underground water is available. Floods in the larger rivers cause considerable damage during heavy rains necessitating expensive protective measures to valuable property and cultivation.

ii. Development through multi-purpose projects.

The question therefore arises as to what would be the best solution to the present problems. The answer to this is an integrated river basin development. Water has to be stored in a large scale and its utilisation so planned not only for irrigation and flood control but also for power development, industrial and domestic supply, fish culture, preservation of wild-life, recreation etc. Thus all development should be planned as integral parts of a comprehensive plan for the development of a basin or region. What is clearly needed is a system in which each separate element fulfils its own special function complementary to the functions of the other elements.

The works undertaken in the past were mainly single purpose schemes designed to meet the immediate requirements. Therefore, development of water resources had been fragmentary approaches to the main problem and its associated problems of flood control, irrigation, land development, hydro-electric power generation, soil conservation and forestry. But when the engineering effectiveness and economic justification of these schemes are considered from the point of view of an overall development pattern the multipurpose concept provides the answer.

2. Planning of Integrated river basin developments.

(a) Manageable unit for planning.

River developments must envisage the development of an area in terms of all its needs and all its resources and are intended to bring about an integrated development. In order therefore to prepare an overall pattern for the development of water resources the most convenient manageable unit appears to be the river basin or in some cases a group of basins. Though a basin may form a unit for planning yet it need not be in complete detail. It can be a framework into which can be fitted in proper sequence all other activities, projects and plans as they get developed stage by stage.

(b) Division of the island into natural river basins.

The first operation in the process of planning has been to divide the entire island with its total surface area of 25,300 sq. miles or about 16,200,000 acres into its various 103 component natural river basins. In addition to these, there are about 94 small coastal tracts, the water potential of which is negligible. Of these 103 river basins, those which have each a drainage area of 100 sq.miles and over have been classed as Major River Basins. There are in all 39 in number and they range from an area of 100 sq.miles each to a little over 4,000 sq.miles, covering an aggregate drainage area of about 20,600 sq.miles which represents 80% of the entire surface area of the country. Grouping of various river basins of the Island into convenient zones or regions indicate that better results could be achieved in the development of the water and land resources. Thus one or more contigouous river basins together with a few adjacent minor river basins are considered as a zone or region, where the water resources of all the component basins are first pooled together and then allocated among the individual basins.

(c) Rivers in Wet and Dry Zones.

The total discharge of all rivers is estimated at 32,722,000 Ac.ft. The catchment areas of the wet zone drain 18,987,000 ac.ft. say 58% of the total run-off on the island with a ratio of run-off to rainfall of 56%. The catchment areas of the dry zone some of them partially located in the wet zone, drain 13,735,000 ac.ft. with ratio of run off to rainfall of 20%. There are 330,000 acres of lands which receive irrigation at present in the dry zone. It is estimated that a further 3.5 million acres of land are available for future development.

Of the 39 major river basins 29 are located in the dry zone and 10 in the wet zone. By far the largest river basin in the island is that of Mahaweli Ganga, covering a drainage area of 4,034 sq.miles of which an extent of 820 miles lies in the wet zone and the balance of 3,214 sq.miles in the dry zone. The problem in the wet zone is more of drainage, that is quick exit of the surplus water to the sea, and prevention of floods than of irrigation, due to the fact that wet zone rivers are perennial. In the dry zone on the other hand, the problem is two-fold namely (a) conservation of the water resources and (b) drainage and prevention of floods. Since the wet zone is fairly well developed agriculturally, the future development from the point of view of irrigated agriculture has to be in the dry zone which with

its total drainage area of 19,000 sq.miles comprises 86 river basins. For the most effective planning it has been found necessary to group these 86 basins into 20 zones or regions.

3. Possible consequences of Projects on other potential users.

(a) Within-Basin Projects.

The Pattern of development for dry zone river basins envisages the utilisation of the entire water resources of the basin for the maximum development of that basin. Projects formulated will be within-basin Projects designed to bring out in general the ultimate potentialities for future development.

An assessment of the available water resources is first made and after allocating the resources to existing developments within the basin, quantity available for potential development is ascertained. The potential development envisaged in the dry zone area is mainly irrigation under rice and therefore land required for such development is also easily obtained. It has been found that lands in the dry zone are generally suitable for rice cultivation but land use surveys are later made to select the best lands which would give maximum income from the proposed cultivations. The within-basin projects are therefore developed so as to serve the needs of the existing developments as well as those of the potential users who will be brought into the areas mainly for irrigated agriculture as envisaged in the development plans of the basin.

Water before being issued for cultivation will be passed through hydro-power plants for the generation of electricity, if economically feasible. This has been found to be so in some of the projects investigated. However maximum development of hydro-electric power based on the resources available cannot be achieved in the dry zone as water required for irrigation has prbrity over power generation in the dry zone areas.

(b) Trans - basin diversions.

Studies made in some basins may indicate the need and desirability for importing water for use within a basin from an adjoining natural drainage basin. This would result in a corresponding reduction of within - basin uses. There is already a proposal to export water from the upper catchment of the Mahaweli Ganga which lies in the wet zone, to an adjoining basin for supplemental irrigation to 97,000 acres of existing cultivations to enable those lands to produce two crops a year instead of the one crop which obtains at present, and supply to 118,000 Acres of new lands. This is being done as an urgent measure to increase rice production.

(c) Ground water resources.

Greater part of the dry zone with the exception of the North-West Coastal belt, is composed of a complex of ancient crystalline rocks which have no capacity to hold or transmit water except where they are decomposed or disentegrated to appreciable depths. Lack of sufficient ground water has caused greater hardships to the settlers in the areas in obtaining water for domestic purposes in the dry

monsoon. It is felt that construction of reservoirs and the irrigation distribution net work in these dry zone areas will hel, replenish under-ground water supply which will be of great benefit to the people who will eventually settle in these regions.

4. Advantages and limitations of Multi-purpose Projects.

Maximum benefits are obtained from the development of a basin through multi-purpose projects as one project contributes to the other what it lacks. All projects are considered integrate units of a basin plan, and as such their economic feasibility is comprehended by the finding of feasibility for the over-all basin plan.

The primary benefit of developing water and land resources in the dry zone is the value of the rice produced by the peasant. Besides this the country gains by saving its external assets which are now used in obtaining it by imports from outside. Thus some benefits are tangible and are subject to measurement in monetary terms while others are less tangible and are not subject to accurate evaluation. A stable agriculture and availability of low cost power, together, provide a sound basis for industrial and commercial expansion and are therefore important to the region in particular and the country in general. These are not readily susceptible of monetary evaluation, but such intangible values have a far reaching effect on the social and economic structure of the country far more than the direct benefits derived from the project.

In order therefore to decide on the feasibility of a project, the benefit-cost ratio alone will not give the true picture when the purpose of the scheme is to develop the resources for the general welfare of the nation. It should not therefore have the same limitations of a private investment. Economic aspects have to be carefully considered in great detail to arrive at the feasibility of a project. Facts that come into consideration are property values, better paying jobs, lower cost of consumer goods, greater opportunity for employment, increase in external assets and greater national security. These no doubt benefits the private individual but in a less developed country it must be realised that on the prosperity of the private individual depends the prosperity of the nation.

5. Walawe Ganga Basin Development.

(a) Walawe Region - General description.

Walawe Ganga Basin has a total drainage area of 954 sq.miles and is located in the south central section of the island. It has a maximum length of about 50 miles and width about 30 miles. Smaller adjoining basins in the lower regions of the Walawe Ganga catchment have been included in the development for more effective planning. The total drainage area is therefore 1183 sq.miles, and the Walawe basin together with the smaller basins will be referred to hereafter as Walawe Region.

The northern portion of the Walawe region covering about one third of the total region area is located in the mountainous territory of what is called the wet zone which comprises the south west sector of the island and has two rainy seasons namely the S.W. and N.E.Monsoons

(April to September and October to March respectively). The rest of the Walawe region is located in the much flatter terrain at much lower elevation, of what is called the dry zone which comprises the balance three quarters of the island and has generally speaking only one rainy season, namely the N.E.Monsoon. The elevation of the upper reaches of the Walawe region ranges from 7,000 feet to 500 feet above M.S.L. The lower region is at an elevation ranging from 300 feet to 100 feet M.S.L.

(b) Walawe Ganga (Walawe river).

The Walawe river is one of the five largest perennial rivers of Ceylon, which has its source at an elevation of about 6,100 feet above M.S.L. in the mountain range known as the Adams Peak range, in the South Central Sector of the island. The river is 85 miles in length and drains a total area of 954 sq. miles and discharges annually a million Ac.ft. of water into the sea. At present all this water goes to waste without being exploited.

(c) Present development of Walawe Region.

i. Present land use.

The present development of the Walawe region is mainly tea plantations, rice fields, coconut and rubber plantations, teak plantations and towns, villages and gardens and covers an extent of 89,000 Acres which is about 14% of the total basin area. The rest of the basin is in jungle of which only small extents, in different parts of the basin have been cultivated with chena crops. Tea lands are located in the mountainous upper areas of the region and rice fields are situated in the flat terrain of the lower basin. Rice is also grown to a limited extent at the foot of the hills in the upper basin, along the banks of the upper reaches of the main Walawe Ganga and also along the banks of the Weli Oya and minor tributaries namely Katupal Oya, Rakwana Ganga and Andalu Ganga. Coconut plantations are more or less concentrated in the valley of the Timbolketiya Ganga and its two tributaries Rakwana Ganga and Andalu Ganga.

ii. Rice Cultivation.

The largest extent of 12,700 acres of existing rice lands in the region is situated in the coastal belt extending on both banks of the Walawe Ganga. These lands are irrigated by the existing Liyangahatota diversion weir constructed some years ago, across the main Walawe River at a site in the lower basin about 13 river miles from the sea. Two main irrigation canals one on each bank of the Walawe Ganga take off from this weir. The right bank canal commands 7,000 acres by direct irrigation while the left bank canal feeds a reservoir called the Ridiyagama Tank which irrigates 5,700 acres of rice lands. There is another diversion scheme called the Uggal-Kaltota Anicut Scheme constructed across Walawe Ganga at the foot hills of the upper basin. This Scheme irrigates 700 acres of rice lands by a right bank canal. Besides these two irrigation projects, there are some minor developments for the cultivation of rice exist in the Walawe Ganga Valley mostly in the upper region. These rice lands are either irrigated by several village tanks or rain fed, and total an extent of 9,000 acres.

iii. Population.

The population of the Walawe Ganga region is of the order of 250,000 which works out to about 260 persons per square mile of the basin. The population; however, as in any other river basin is & not uniformly distributed over the entire region but is concentrated in the areas of present development.

iv. Rainfall.

The mean annual rainfall over the region ranges from 145 inches to 92 inches in the mountainecus areas of the upper basin and 61 inches to 44 inches in the lower valley. For the region as a whole the mean annual rainfall is 82 inches. The region is one of the particular group of dry zone basins, in which on account of the mountainecus territories of the upper regions and their close proximity to the wet zone of the island, the S.W.Monsoon run off (i.e. April to September) is a fair proportion of the total run-off. Thus the rainfall and surface run off are more evenly distributed over the 12 months of the year than in the other basins of the dry zone.

v. Floods.

The maximum flood peak flow 150,000 cusecs and flood volume 670,000 Ac.ft. was recorded at Ambalantota (river mouth) in the Walawe basin in May 1940. The next biggest flood that has occurred in the past is that of August 1947. Floods of much lesser magnitudes have been experienced in other years.

(d) General Pattern of Future Development.

The studies of water resources, land use and geology undertaken have revealed that the general pattern of development of this region has to be mainly on agriculture. While the agricultural development in the hilly portion of the region has to be limited to the intensification of land use and application of conservation measures, the low land plain has been found to be suitable for development of irrigated cultivation over a large part of it. The terrain and drainage pattern of the area are of such a nature as to permit gravitational system of irrigation. The flow of the Walawe could also be harnessed to generate a significant amount of hydro-electric power. There are no mineral deposits in basin which merit development.

In order to obtain the best possible development for both power and irrigation, a system of dams and reservoirs are required as no single dam or reservoir could supply the irrigation and power requirements of a major development. According to the plan envisaged for the region it is proposed to bring under irrigation 107,000 acres for rice cultivation and develop 129 megawatts of installed power. The Project features include the construction of six reservoirs (total capacity 504,000 Ac.ft.) and necessary distribution and drainage systems for the lands commanded by the reservoirs. The possibilities of carrying out the development outlined in the plan envisaged are quite promising. Further investigations and studies have to be carried out to ascertain the physical and economic feasibility of the complete project and its component parts and such studies and investigations have been taken in hand for some of the reservoir projects. Detail investigations and designs were completed in respect of Chandrikawewa

reservoir scheme and this is now under construction. Designs have been prepared for Udawalawe Reservoir Headworks. Preliminary plans have been developed for headworks of Samanalawewa - Katupal Oya Reservoir Systems and it is proposed to bring in landless peasant colonists into this basin in accordance with the policy of the Government to work the lands which will be developed under the Project. Power produced will be very much more than the needs of the area at the present time and the surplus power will be supplied into the main power distribution net work.

(e) Benefits that will accrue from the Project.

The development of the region as envisaged will increase the production of food chiefly rice, and this will go a long way in effecting a saving in external assets a greater portion of which is now used in importing rice and other essential articles of food. The land required for development is Government land and no expenditure is involved in acquisition for project purposes. The availability of low cost power would stimulate industry and would create new opportunities for employment. Constructional activities of the various projects would reduce unemployment in the country and opening up of roads to project sites would make accessible existing village settlements. The construction of many reservoirs would also make a substantial contribution to flood control in the region.

B I B L I O G R A P H Y.

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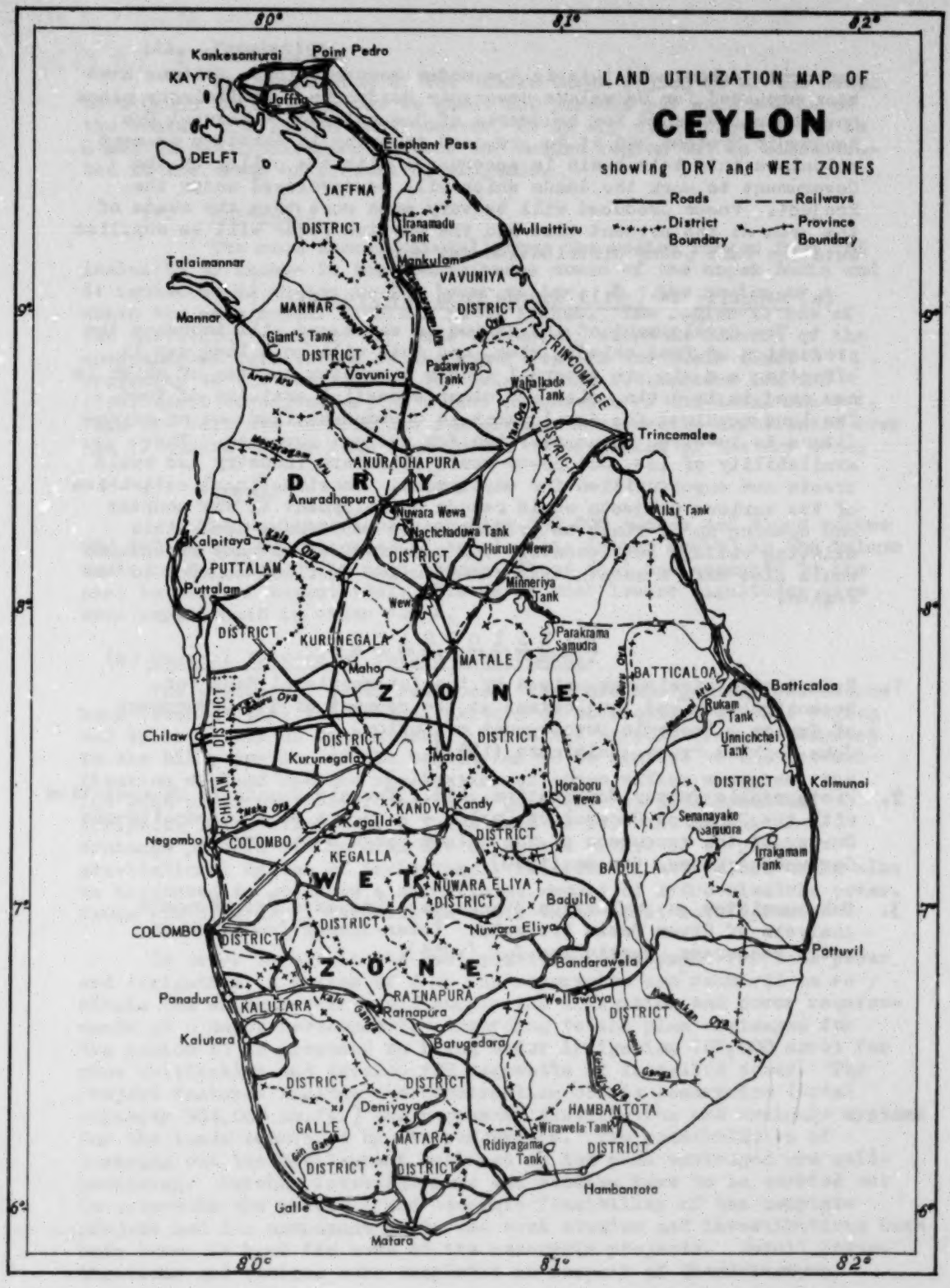
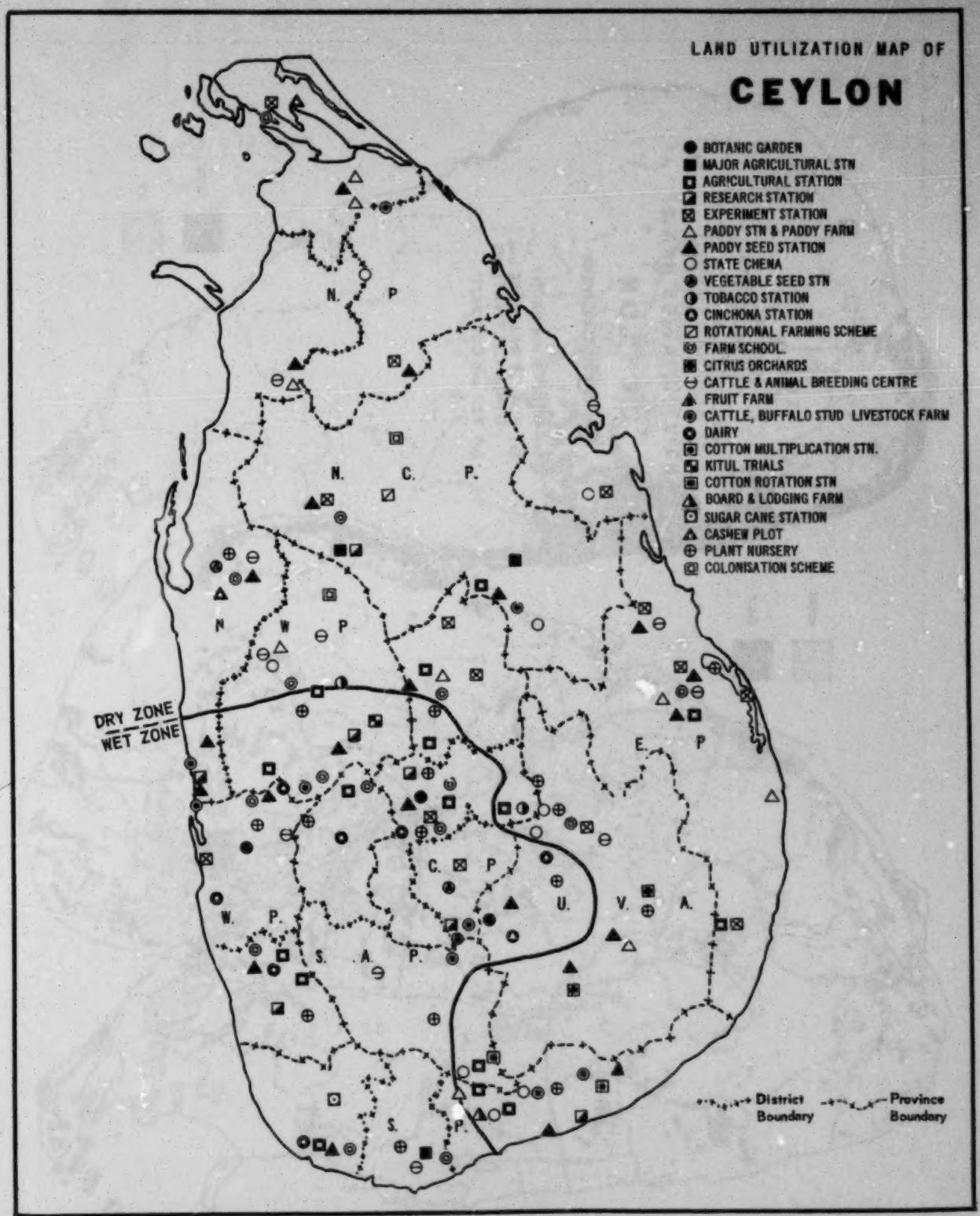

LAND UTILIZATION MAP OF
CEYLON
showing DRY and WET ZONES
Roads
Railways
District Boundary
Province Boundary
80°
81°
82°
9°
8°
7°
6°
Kankesanturai
Point Pedro
KAYTS
Jaffna
DELFT
Elephant Pass
JAFFNA DISTRICT
Iranamadu Tank
Mullaittivu
Talaimannar
Mankulam
VAVUNIYA DISTRICT
MANNAR DISTRICT
Mannar
Giant's Tank
Vavuniya
Padawiya Tank
Nuwara Aru
Yan Oya
TRINCOMALEE DISTRICT
Trincomalee
Wahalkada Tank
Mahaweli Ganga
ANURADHAPURA DISTRICT
DRY ZONE
Anuradhapura
Nuwara Wewa
Nachchaduwa Tank
Hurulu Wewa
Kalpitaya
Kala Oya
PUTTALAM DISTRICT
Puttalam
Minneriya Tank
Wewa
Parakrama Samudra
KURUNEGALA DISTRICT
Maho
MATALE DISTRICT
Deduru Oya
Chilaw
Kurunegala
Matale
Horaboru Wewa
KANDY DISTRICT
Kandy
Kegalla
Negombo
COLOMBO DISTRICT
KEGALLA DISTRICT
WET ZONE
NUWARA ELIYA DISTRICT
Badulla
Nuwara Eliya
COLOMBO DISTRICT
Bandarawela
Pottuvil
Panadura
KALUTARA DISTRICT
RATNAPURA DISTRICT
Ratnapura
Wellawaya
Kalutara
Batugedara
Kalu Ganga
DISTRICT
Deniyaya
HAMBANTOTA DISTRICT
GALLE DISTRICT
MATARA DISTRICT
Wirawela Tank
Ridiyagama Tank
Hambantota
Galle
Matara
BATTICALOA DISTRICT
Batticaloa
Rukam Tank
Unnichchai Tank
Kalmunai
Senanayake Samudra
Irrakamam Tank
BADULLA DISTRICT


LAND UTILIZATION MAP OF
CEYLON
BOTANIC GARDEN
MAJOR AGRICULTURAL STN
AGRICULTURAL STATION
RESEARCH STATION
EXPERIMENT STATION
PADDY STN & PADDY FARM
PADDY SEED STATION
STATE CHENA
VEGETABLE SEED STN
TOBACCO STATION
CINCHONA STATION
ROTATIONAL FARMING SCHEME
FARM SCHOOL.
CITRUS ORCHARDS
CATTLE & ANIMAL BREEDING CENTRE
FRUIT FARM
CATTLE, BUFFALO STUD LIVESTOCK FARM
DAIRY
COTTON MULTIPLICATION STN.
KITUL TRIALS
COTTON ROTATION STN
BOARD & LODGING FARM
SUGAR CANE STATION
CASHEW PLOT
PLANT NURSERY
COLONISATION SCHEME
DRY ZONE
WET ZONE
N. P
N. C. P.
N W P
E. P
C. P
W. P.
S. A. P.
U.
V.
A.
S. P.
District Boundary
Province Boundary

LAND UTILISATION MAP OF

CEYLON

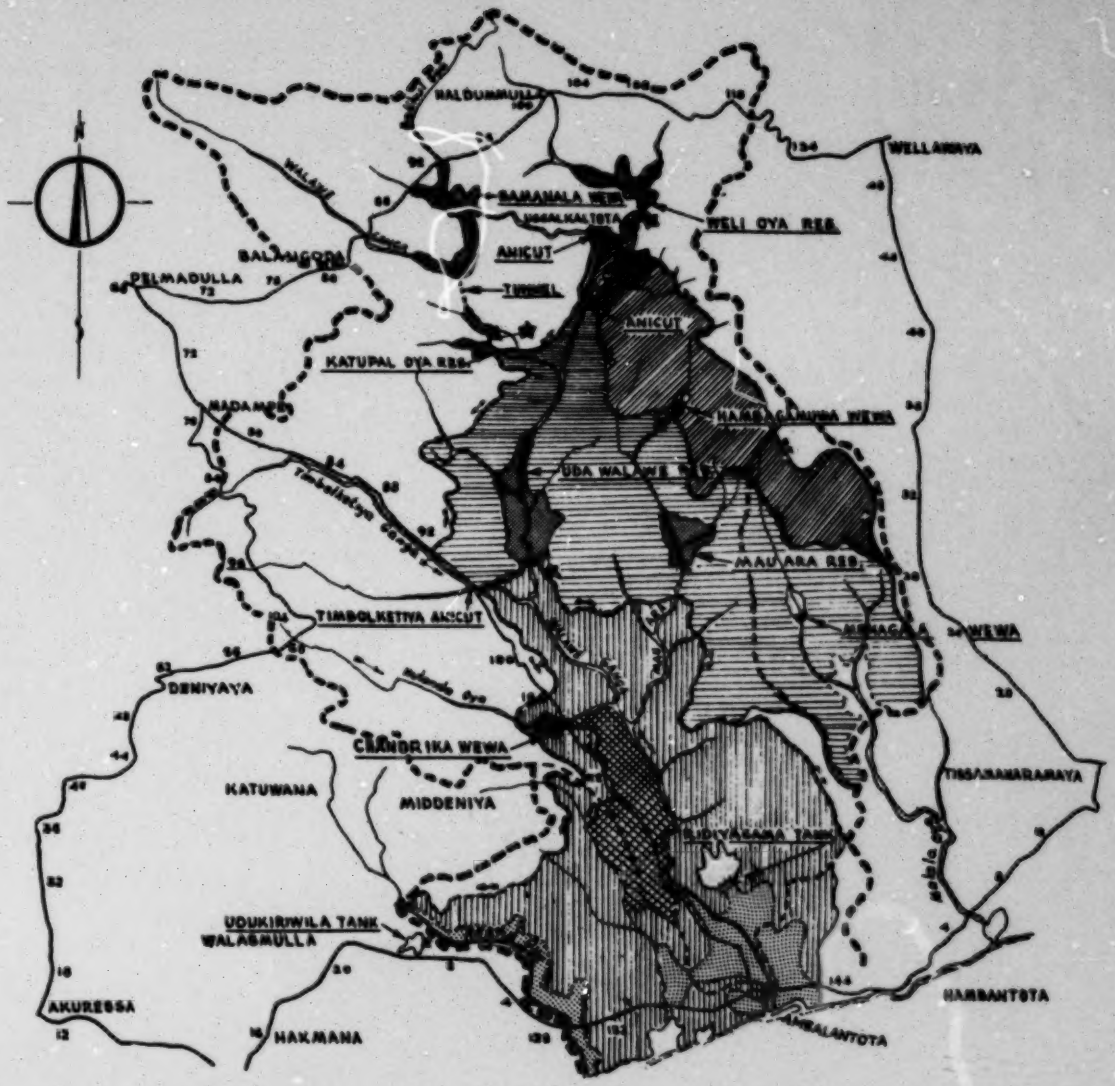
Showing areas of cultivation

(a) RUBBER and PADDY
(b) FOREST RESERVES and OTHER CULTIVATIONS
(c) TEA and COCONUT

TEA
COCONUT

FOREST RESERVES
OTHER CULTIVATIONS

CEYLON
DISTRIBUTION OF RURAL AND URBAN POPULATION
1946
EACH DOT REPRESENTS 1,000 PERSONS
250,000 PERSONS
62,500 PERSONS
DRY ZONE
WET ZONE
COLOMBO
CEYLON
RIVER BASINS
REFERENCE.
WALAWE BASIN BOUNDARY
WALAWE REGION "
WALAWE
DRY ZONE
WET ZONE
N
0 10 20 30 40 50
MILES



RESERVOIR	ACTIVE STORAGE CAPACITY AC. FT.	INSTALLED POWER	EXTENT OF IRRIGATION AGRICULTURE	LEGEND
SAMANALA WEWA	118,600	120 M.W.	38,300	
" PORAGAY RES.	8,400			
KATUPAL OYA RES.	44,300			
UDAWALAWE RES.	180,000	5 M.W.	47,000	
WELI OYA RES	117,000	4 M.W.	18700	
MAU ARA RES	17,600			
CHANDRIKAWEWA	20,000		5000	
TOTAL	505700	139 M.W.	107,000	

4 3 2 1 0 4 8

MILES

WALAWE REGION DEVELOPMENT PROJECT

EXISTING DEVELOPMENTS .....

NEW RESERVOIRS SHOWN THUS .....

POWER PLANTS -30- -90- .....

MAIN CANAL SYSTEM .....

WALAWE REGION BOUNDARY .....

23 E - Oct.1962 - 1,500